REMARKS

Claims 1-20 are now pending in this application. Claims 1-13 are rejected. Claim 9 is objected to. New claims 14-20 are added. Claims 1-10 and 13 are amended herein to clarify the invention and to address matters of form unrelated to substantive patentability issues. For the convenience of the Examiner, APPENDIX I is provided herewith having a complete set of pending claims with all amendments effected therein.

CLAIM REJECTIONS UNDER 35 U.S.C. §103(a)

Claims 1 and 2 are rejected as obvious over the Hayakawa reference in view of the Bailey reference under 35 U.S.C. §103(a). Claim 1 is rejected as obvious over the Hayakawa reference in view of the Pan reference under 35 U.S.C. §103(a). Claims 3 and 4 are rejected as obvious over the Hayakawa reference in view of the Pan reference and further in view of the Eldada reference under 35 U.S.C. §103(a). Claims 1, 5 and 6 are rejected as obvious over the Hayakawa reference in view of the Morey reference under 35 U.S.C. §103(a). The remaining claims are variously rejected as obvious in view of the aforesaid reference. The applicant herein respectfully traverses these rejection. For a rejection under 35 U.S.C. §103(a) to be sustained, the differences between the

features of the combined references and the present invention must be obvious to one skilled in the art.

It is respectfully submitted that a *prima facie* case of obviousness cannot be established in rejection of the amended claims or the new claims. "To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on the applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)." MPEP §706.02(j) "Contents of a 35 U.S.C. §103 Rejection".

Before addressing the amended independent claims, applicants address the rejection of claim 12 which is directed to the use of the plastic material as the heat sensitive expandable member. The Examiner theorizes that one would turn to the use of plastic, without any such guidance from the reference, because it is known that plastics have a higher coefficient of expansion than metal and the artisan would be "motivated to use plastic-type materials for at least the purpose of crating a

device with increased sensitivity to temperature, that will match the temperature sensitivity of a fiber grating."

It is respectfully submitted that one skilled in the art would not be so motivated because matching the temperature sensitivity of the fiber grating is irrelevant to any need addressed in the references or the present invention. One skilled in the art would seek to match frequency shift due to temperature shift of the tuning range of the conversion device, not the expansion of the fiber. To match the expansion of the fiber would serve no use because the fiber would expand anyway at the inherent rate if the materials match its rate.

The purpose of the invention is forcibly expand the fiber at a rate so as to match optical characteristics of the fiber to the optical characteristics of the conversion device. Nothing in any of the references suggests that plastics have temperature coefficient which would be useful in matching the characteristics of the conversion device. The Examiner suggests that a large temperature coefficient would drive one to choose plastics. However, as anyone skill in the art of engineering devices to operate over large temperature ranges will attest to, a large coefficient is not necessarily desirable and is often the source of difficulties. One seeks to match temperature characteristics which may often require small coefficients. As such one would not be led to the use of plastics in accordance with the motivation proposed by the Examiner. Thus it is respectfully submitted

that a prima facie case of obviousness has not been establish because the feature of using plastic as the expandable material is not shown and the Examiner's proposed motivation for one to turn to plastics has no operability, thus one skilled in the art would not be so motivated.

Turning next to the amended claims, it is submitted that the combination of specific features now recited are not rendered obvious by the cited references because there is no suggestion to make the combination and, even more importantly, there is no suggestion that such a combination would have a reasonable expectation of producing a successful device.

It is well settled that features of prior art references may not be assembled to establish obviousness using the pending claims as a template. Indeed, the court in *In re Fritch*, 23 USPQ 2d 1780, 1783–84 (Fed. Cir. 1992) stated the following:

> "Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching or suggestion supporting the combination. Under section 103, teachings of references can be combined *only* if there is some suggestion or incentive to do so." (quoting *ACS Hosp. Systems, Inc. v. Montefiore Hosp.*, 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984)). . . . The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification.

Thus, the prior art reference must suggest some desirable attribute for making the proposed combination and not just provide an alternative.

The inventions as presented in claims 1 and 7 and the device disclosed in the Hayakawa reference are different from each other in the significant aspect that the presently claimed invention has a "fiber Bragg grating" (called FBG hereunder) that is tunable, that the material for the wavelength conversion device is one of lithium niobate, lithium tantalate, or their MgO doped form, and that the wavelength of the input light is 900 - 1100 nm. In such waveguide passage types of wavelength conversion device the tolerance for wavelength deviation is only 0.1 nm. An FBG and the resonator made in commercial production have an inherent variability of quality caused inevitably from manufacturing variations. Hence, Hayakawa's individual laser, even when merely set to have the same material for the wavelength conversion device and the same wavelength of the input light as those referred to in our present invention, would not be readily capable of providing stable output. This problem is not at all suggested in any of the applied prior art documents.

The present invention solves the problem by use of the adjustable wavelength of the FBG. Although the features that the wavelength conversion device employs Li + Nb with MgO doped thereto and that FBG is extensible to adjust the wavelengths are variously mentioned in the cited documents, the foregoing problem is not known in the art so that there should be no motivation of applying the claimed features to the Hayakawa invention, i.e., the feature of FBG

being tunable in combination with the claimed conversion device. Therefore, the references do not provide the requisite suggestion to one skilled in the art to arrive at the now claimed invention. Specifically, there is nothing to suggest that using the expanding means would successfully compensate for frequency range input drift when such tight tolerances are demanded.

The materials referred to in claims 1 and 7 result in a rate of change of wavelength with temperature of the wavelength conversion device that is about 0.06 [nm/K]. In the meantime, the tolerance of wavelength in the waveguide passage type of wavelength conversion device is only 0.1 [nm]. However, in order to extend the FBG, the heat-sensitive extendable member is employed and its coefficient of linear expansion is set to be between $5*10^{-5}$ [K^{-1}] and $6*10^{-5}$ [K^{-1}], correspondingly to Claim 11. This provides such an effect that the rate of change of wavelength temperature of the wavelength conversion device does substantially correspond to that of the FBG as far as the wavelength conversion device and the FBG have the same temperature change as described in the specification. As a result, output of light is obtainable that is stable irrespective of temperature change.

Although cited documents disclose using a temperature sensitive extensible member for extending FBG, none of the cited documents disclose or suggest the specific features of the claimed invention in claims 1 and 7 that include the

wavelength conversion device employing lithium niobate, lithium tantalate, or their Mgo doped form, and that the wavelength of the input light being 900 - 1100 nm. Furthermore the aforesaid combination of features is not suggested in combination with an expandable member having a coefficient of linear expansion set to be between $5*10^{-5}$ [K^{-1}] and $6*10^{-5}$ [K^{-1}] as recited in claim 9. Thus, there is no teaching that the would provide one with a reasonable expectation of success in making the claimed combination work successfully.

Thus, it is respectfully submitted that the rejected claims are not obvious in view of the cited references for the reasons stated above. Reconsideration of the rejections of claims 1-13 and their allowance are respectfully requested.

BASIS FOR PATENTABILITY OF NEW INDEPENDENT CLAIM

Claim 14 is added and are submitted as patentable over the cited art of record. Independent claim 14 recites subject matter directed to an adjustable lead screw which is "formed of heat sensitive material having a linear expansion coefficient sufficient to expand said tunable Bragg grating such that said resonance wavelength of the optical resonator output light remains within said temperature induced shift of said wavelength range for input light of said wavelength conversion device and said second harmonic output is substantially stable over a temperature range of operation." While the cited references refer to expandable

materials, or mechanically controlling dimensions of grating devices, none of the reference suggest the combined use of the heat expandable material in a device, such as a lead screw, which adjusts the length of the Bragg grating, which, among other features recited therein, is not believed disclosed in the cited art in the manner as claimed. Dependent claims 15-20 are patentable based on the subject matter recited therein in addition to the subject matter of claim 14, in particular the subject matters of the claims relating to the specific materials, wavelength ranges, and thermal coefficient ranges, combinations of which are not rendered obvious by the references for lack of providing the requisite motivation and reasonable expectation of success.

CLAIM FEES

Three claims in excess of twenty are added. Accordingly, please charge the fee of $150 to Deposit Account No. 10-1250.

REQUEST FOR EXTENSION OF TIME

Applicant respectfully requests a two month extension of time for responding to the Office Action. Please charge the fee of $450.00 for the extension of time to Deposit Account No. 10-1250.

If there is any discrepancy between the fee(s) due and the fee payment authorized in the Credit Card Payment Form PTO-2038 or the Form PTO-2038 is missing or fee payment via the Form PTO-2038 cannot be processed, the USPTO is hereby authorized to charge any fee(s) or fee(s) deficiency or credit any excess payment to Deposit Account No. 10-1250.

In light of the foregoing, the application is now believed to be in proper form for allowance of all claims and notice to that effect is earnestly solicited.

Respectfully submitted,
JORDAN AND HAMBURG LLP

By F J Jordan
Frank J. Jordan
Reg. No. 20,456
Attorney for Applicants

by and,

By H F Ruschmann
Herbert F. Ruschmann
Reg. No. 35,341
Attorney for Applicants

Jordan and Hamburg LLP
122 East 42nd Street
New York, New York 10168
(212) 986-2340

APPENDIX I

ALL PENDING CLAIMS WITH AMENDMENTS EFFECTED THEREIN

1. (Currently Amended) A wavelength conversion laser apparatus comprising:

a semiconductor light emitting device;

an optical fiber having a tunable Bragg grating provided therein and a fiber input end and a fiber output end;

an optical resonator formed of the semiconductor light emitting device arranged to input light into said optical fiber and receive reflected light from said optical fiber to effect a resonance at a resonance wavelength determined by a grating wavelength of said Bragg grating, said optical resonator providing optical resonator output light at said resonance wavelength at an output end of said optical fiber;

a wavelength conversion device formed of a nonlinear optical crystal formed from one of the group consisting of lithium niobate, lithium tantalate, MgO doped lithium niobate, and MgO doped lithium tantalate, and having a wavelength range for input light ranging from 900 nm to 1100nm, said wavelength conversion device receiving as the input light said optical resonator output light from said optical resonator and releasing a harmonic of the input light; and

a grating expanding means for expanding the tunable Bragg grating in a lengthwise direction of the Bragg grating to match the resonance wavelength of the optical resonator output light with the wavelength range of the input light such that the resonance wavelength of the input light can be converted by the wavelength conversion device.

2. (Currently Amended) A wavelength conversion laser apparatus according to claim 1, wherein the grating expanding means comprises a base having a first retainer provided for securing the optical fiber, a movable nut arranged for slidably moving on the base and having a second retainer provided for securing the optical fiber, a lead screw threaded with the movable nut and an end engaging the base, and a rotating means for rotating the lead screw.

3. (Currently Amended) A wavelength conversion laser apparatus according to claim 1, wherein the grating expanding means comprises a bar-like heat-sensitive expandable member for securing the optical fiber at two locations between which the tunable Bragg grating is installed and a heating means for heating the heat-sensitive expandable member to increase a distance including the tunable Bragg grating between the two locations.

4. (Currently Amended) A wavelength conversion laser apparatus according to claim 3, wherein the heat-sensitive expandable member comprises two or more materials which have different linear expansion coefficients and are bonded to each other.

5. (Currently Amended) A wavelength conversion laser apparatus according to claim 1, wherein the grating expanding means comprises a heat-sensitive expandable member of a ring or disk shape having an outer side on which a portion of the optical fiber including the tunable Bragg grating is wound and a heating means for heating the heat-sensitive expandable member to expand the outer side.

6. (Currently Amended) A wavelength conversion laser apparatus according to claim 1, wherein the grating expanding means comprises a bar-like piezoelectric

member arranged to secure the optical fiber at two locations between which the tunable Bragg grating is installed and a voltage impressing means for supplying the piezoelectric member with a voltage to increase a distance between the two locations.

7. (Currently Amended) A wavelength conversion laser apparatus comprising:

a semiconductor light emitting device;

an optical fiber having a tunable Bragg grating provided therein and a fiber input end and a fiber output end;

an optical resonator formed of the semiconductor light emitting device arranged to input light into said optical fiber and receive reflected light from said optical fiber to effect a resonance at a resonance wavelength determined by a grating wavelength of said Bragg grating, said optical resonator providing optical resonator output light at said resonance wavelength at an output end of said optical fiber;

a wavelength conversion device formed of a nonlinear optical crystal formed from one of the group consisting of lithium niobate, lithium tantalate, MgO doped lithium niobate, and MgO doped lithium tantalate, and having a wavelength range for input light ranging from 900 nm to 1100nm, said wavelength conversion device receiving as the input light said optical resonator output light from said optical resonator and releasing a harmonic of the input light; and

a resonant wavelength adjusting means for adjusting the resonance wavelength of the optical resonator output light in accordance with temperature so as to maintain the harmonic of the light from the wavelength conversion device substantially constant regardless of a change in the temperature of the wavelength

conversion device by substantially matching a temperature induced shift of said wavelength range for input light of said wavelength conversion device.

8. (Currently Amended) A wavelength conversion laser apparatus according to claim 7, wherein the resonant wavelength adjusting means is a grating expanding means which is heat sensitive for expanding the tunable Bragg grating in a lengthwise direction of the tunable Bragg grating.

9. (Currently Amended) A wavelength conversion laser apparatus according to claim 7, wherein the grating expanding means is a bar-like heat-sensitive expandable member which secures the optical fiber at two locations between which the tunable Bragg grating is located.

10. (Currently Amended) A wavelength conversion laser apparatus according to claim 8, wherein the grating expanding means is a heat-sensitive expandable member of a ring or disk shape having an outer side on which a portion of the optical fiber including the tunable Bragg grating is wound.

11. (Previously Presented) A wavelength conversion laser apparatus according to claim 9 or 10, wherein the heat-sensitive expandable member has a linear expansion coefficient of $5*10^{-5}$ [K^{-1}] - $6*10^{-5}$ [K^{-1}].

12. (Previously Presented) A wavelength conversion laser apparatus according to claim 9 or 10, wherein the heat-sensitive expandable member is made of a plastic material.

13. (Currently Amended) A wavelength conversion laser apparatus according to claim 9 or 10, wherein the heat-sensitive expandable member comprises two or more materials which have different linear expansion coefficients and are bonded to each other.

14. (New) A wavelength conversion laser apparatus comprising:

a semiconductor light emitting device;

an optical fiber having a tunable Bragg grating provided therein and a fiber input end and a fiber output end;

an optical resonator formed of the semiconductor light emitting device arranged to input light into said optical fiber and receive reflected light from said optical fiber to effect a resonance at a resonance wavelength determined by a grating wavelength of said Bragg grating, said optical resonator providing optical resonator output light at said resonance wavelength at an output end of said optical fiber;

a wavelength conversion device formed of a nonlinear optical crystal and has a wavelength range for input light, said wavelength conversion device receiving as the input light said optical resonator output light from said optical resonator and releasing a harmonic of the input light;

a resonant wavelength adjusting means for adjusting the resonance wavelength of the optical resonator output light in accordance with temperature so as to maintain the harmonic of the light from the wavelength conversion device substantially constant regardless of a change in the temperature of the wavelength conversion device by substantially matching a temperature induced shift of said wavelength range for input light of said wavelength conversion device;

said resonant wavelength adjusting means being a grating expanding means which is heat sensitive for expanding the tunable Bragg grating in a lengthwise direction of the tunable Bragg grating, said grating expanding means including:

first and second retainers securing the optical fiber at first and second position with said tunable Bragg grating disposed therebetween;

an adjustable lead screw;

said first retainer being movable in the lengthwise direction of the tunable Bragg grating by means of a threaded coupling with said lead screw;

said lead screw having an end rotatably disposed at a position fixed relative said second retainer; and

said lead screw being formed of heat sensitive material having a linear expansion coefficient sufficient to expand said tunable Bragg grating such that said resonance wavelength of the optical resonator output light remains within said temperature induced shift of said wavelength range for input light of said wavelength conversion device and said second harmonic output is substantially stable over a temperature range of operation.

15. (New) A wavelength conversion laser apparatus according to claim 14, wherein said linear expansion coefficient is in the range of $5*10^{-5}$ [K^{-1}] to $6*10^{-5}$ [K^{-1}].

16. (New) A wavelength conversion laser apparatus according to claim 15, wherein said nonlinear optical crystal is formed from one of the group consisting

of lithium niobate, lithium tantalate, MgO doped lithium niobate, and MgO doped lithium tantalate.

17. (New) A wavelength conversion laser apparatus according to claim 16, wherein said wavelength range for input light ranges from 900 nm to 1100nm.

18. (New) A wavelength conversion laser apparatus according to claim 14, wherein said nonlinear optical crystal is formed from one of the group consisting of lithium niobate, lithium tantalate, MgO doped lithium niobate, and MgO doped lithium tantalate.

19. (New) A wavelength conversion laser apparatus according to claim 18. wherein said wavelength range for input light ranges from 900 nm to 1100nm.

20. (New) A wavelength conversion laser apparatus according to claim 14, wherein said wavelength range for input light ranges from 900 nm to 1100nm.